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Selection and educational attainment: Why some children are left behind? Evidence from a middle-income country.

Luciana Méndez-Errico[*] and Xavier Ramos[†]

Abstract

We model schooling as a sequential process and examine why some children are left behind. We focus on the factors that explain selection at early stages of the education system. Our findings for Uruguay suggest that long-term factors, such as parental background or ethnicity matter across all education stages while the effect of short-term factors, such as family income, wear out as individuals progress in the education system, suggesting a severe selection process at early stages.

JEL codes: I20, I24, J13, J15, J24
Keywords: Schooling transition, selection, inequality, education, ethnicity, cognitive and non-cognitive abilities, sequential dynamic model.

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1. Introduction

Schooling is a sequential process, where performance at one stage conditions the available choices and success at subsequent educational stages. At each stage of the educational path there is a selection process driven by factors known to influence education performance of students. Previous evidence suggests that some factors have a larger influence at the early stages of schooling while others are more important in the later stages of the educational path. For instance, Cunha and Heckman (2008) find that parental inputs have different effects over the child's life cycle, cognitive skills being more important at early ages and non-cognitive skills affecting more at later ages.

The different roles played by cognitive abilities, socio-emotional factors, and family background in skill formation in different periods of childhood or adolescence calls for alternative policies in time (Heckman and Mosso, 2014). Hence, finding out what factors are most important at every stage of the education process is key to shape interventions and exploit the effective margins for social policy (Heckman and Mosso, 2014; Heckman, Pinto, and Savelyev, 2013).

Following recent literature we distinguish between long-term family factors, such as parental background, ethnicity, cognitive and non-cognitive abilities, in explaining individuals' education attainment (Bowles and Gintis, 2001 and 2002; Cameron and Heckman, 1998, 2001; Carneiro et al., 2007; Heckman and Mosso, 2014), and short-term factors, such as liquidity constraints, which have captured the attention of a substantial part of the literature (Keane and Wolpin, 2001; Belley and Lochner, 2007; Akee et al., 2010; Lochner and Monje-Naranjo, 2012).

Using unique matched survey data on youth, which contains retrospective information, and nationally representative survey data from their parents, we study the importance of long- and short-term factors for educational attainment in a middle-income country—Uruguay— and pay special attention to the different effects of these long- and short-term family factors across the different stages of schooling, from lower secondary to post-secondary education. To this end, we employ a dynamic educational model due to Cameron and Heckman (1998, 2001) in which schooling attainment is modelled as the outcome of sequential educational choices. Additionally, the model also accounts for individual unobserved heterogeneity, that could arise from time preferences, risk aversion or motivation, and which is likely to affect individuals' schooling progression.

We thus contribute to the literature that takes proper account of the sequential nature of educational systems when modelling education attainment and transitions,

especially for developing countries. Most of the existing evidence focuses on developed countries: Bernardi (2012) uses data for Spain; Holm and Jaeger (2011) uses British data, Karlson (2011) uses Danish data. To our knowledge, Pal (2004) is the only study for a Latin American country, Peru. Pal (2004) fits a sequential probit model due to Lillard and Willis (1994), which does not fully capture the dynamics and the selection at each stage, as it does not allow the unobservables at each schooling stage to be correlated.

Uruguay provides an interesting case-study. Contrary to many other Latin American countries, Uruguay has a large tradition of publicly-provided and freely-accessible education.[1] Social cohesion is also large, relative to other countries in the region, with low poverty and inequality (Cepal, 2013). Despite these two good features, a large percentage of students do not complete high school. This share is also much larger than the share of other countries in the region characterized by a private education system, especially at the university level, and lower levels of social cohesion, such as Chile (SITEAL, 2005). The relevant question then is why children living in Uruguay do not attain higher levels of education, despite the great supply of public education.

Our findings suggest that long-term factors matter across all education stages while the effect of short-term factors wear out as individuals progress in the education system, suggesting a severe selection process at early stages. This picture is consistent with previous findings.[2]

Our results suggest that despite the great supply of public education some children are left behind. The reasons, we found, are long-term family factors. Students with more favourable parental educational background and with better performance in the educational system are more likely to survive higher schooling stages. Ethnicity is an important factor preventing schooling progression for girls and, to a lesser extent, also for boys. Less motivated individuals and those engaged in risky behaviours are less likely to survive early schooling stages and therefore to attain higher education. In addition, short-term family income, measured as the opportunity cost of education at each schooling

[1] Primary school was made compulsory in 1877, universal primary schooling was achieved in the 1950s (Manacorda, 2012).

[2] Previous studies for Uruguay show that lower high school drop-out is strongly associated with parental educational background, household income, adolescents' socio-emotional factors like taste for maths and science in primary school, and repetition (Failache et al., 2018; de Melo and Machado, 2015). Motivation and labour motives are pointed out by adolescents as the main issues inducing dropping-out from the educational system (Cardozo, 2010). Ethnicity has also been found to shape educational attainment in Uruguay (Porzecanski, 2008).

level, has decreasing effects across the educational path; turning less important –in comparison to long-term family factors– the higher we move on the educational path.

Our findings support the literature which suggests that early child's life cycle is a sensitive period for the formation of cognitive skills and has persistent effects on higher stages of the schooling transition. Also, non-cognitive ability, despite data limitations for its measurement, is seen to be an important factor affecting schooling progression. Thus, our results call for public interventions focused on cognitive and non-cognitive abilities at different stages of the life cycle to compensate children from disadvantaged parental backgrounds.

The remainder of this paper is organized as follows. Section 2 describes the relevant features of the education system in Uruguay. Section 3 describes the data and shows suggestive evidence about the selection that takes place at each schooling stage, and about the differential effect of relevant variables. Section 4 outlines the econometric methods, and Section 5 discusses the main findings. Finally, Section 6 concludes.

2. The Educational System in Uruguay

The educational system in Uruguay is organized in four levels: pre-school, primary education (grades 1 to 6, ages 6-11), secondary level, which includes lower high school (*Ciclo básico,* grades 7 to 9, ages 12-14) and upper high school (*Bachillerato,* grades 10 to 12, ages 15-17); and tertiary level (university and teaching training institutes). Primary and lower high school levels are compulsory.[3] Lower and upper high school are offered in both non-vocational secondary schools (*liceos*), which host about 83% of all students, and vocational schools (*UTUs*), which host the remaining 17%. The different schooling stages are both publicly and privately provided. As pointed out in the Introduction, however, most of the schooling supply is public: overall, 77% of students have always gone to public school.[4] Chart 1 describes the different stages of the education system and Table 2 describes the composition of students in the three stages of the education system.

An important feature of the post-secondary stage is that universities and private colleges are located mainly in the capital city Montevideo. The largest one, *Universidad de la República* (UdelaR), is public and freely provided; students do not have to pay any

[3] Enforcement of compulsory schooling laws is lax, as in many developing countries (Manacorda, 2012). That is why we observe children dropping out from lower high school.

[4] By education level, shares are 78.3% for lower high school, 71.8% for upper high school, 80% for university, and 78% for non-university high education.

tuition or pass any entrance exam.[5] Thus, students residing outside Montevideo face higher costs, as they have to move or commute to the capital city.

Figure 1 shows raw survival rates at the different schooling stages for our sample of individuals aged 20 to 29. The black solid line clearly shows the selection process of the education system. While on average nearly all students finish primary school, one third does not complete lower high school, another third does not make it to upper high school, and only one fifth reach post-secondary education. Completion rates are systematically higher for females and non-afro. Of course, if this selection process is not random examining the determinants of academic success at the different stages of the education process as if the sample was not selected leads to biased results. The sequential dynamic discrete choice model we employ takes proper account of these selection issues.

3. Data and descriptive statistics

We match information from two nationally representative data sets, which interviewed the same households: the 2008 National Youth Survey (ENAJ, *Encuesta Nacional de Adolescencia y Juventud*) and the 2008 Continuous Household Survey (ECH, *Encuesta Contínua de Hogares*). The ENAJ interviews individuals aged 12 to 29 living in cities larger than 5,000 inhabitants[6] drawn from the original sample of households of the ECH, which is a larger survey providing information on living standards for the whole population. We restrict the ENAJ sample to 2,349 individuals aged 20 to 29, who are supposed to have completed at least secondary education. It is important to note that the ENAJ interviews young individuals belonging to the households sampled by the ECH, but who are nonetheless not interviewed by the latter dataset because they moved out. Thus, we have information of young individuals both co-residing and not co-residing with their parents, which allows us to avoid biases that arise from working with a selected sample of youth conditional on living with their parents (Francesconi and Nicoletti, 2006).

Information on complete educational trajectories including performance indicators, such as repetition, family background, motives for attending secondary school, and risky behaviours of interest, such as drug consumption, are drawn from the ENAJ

[5]Since 2007 the UdelaR is making big efforts in terms of territorial decentralization to give greater opportunities to students living outside the capital city. Likewise, some private universities start locating in different regions of the country.

[6] 87% of the population aged 20 to 29 lives in cities larger than 5,000 inhabitants, according to the 2011 Census.

dataset, while socio-economic characteristics and other relevant variables are drawn from the ECH dataset.

Table 1 provides summary statistics for the final sample, by gender and ethnicity. More than half of the sample is female (52%) while the proportion of afro-descendants is 11%.[7] Afro and non-afro descendants show markedly different distributions of parental educational backgrounds. While the proportion of non-afro-descendants with high educated parents triples that of afro descendants, the share with low educated parents is 20% higher among afro descendants.

Table 2 presents summary statistics for different schooling levels for girls and boys (panels A and B respectively). Four main observations are worth making. First, schooling transitions are more selective for children from worse-off parental background. At every education stage, dropping out children come mostly from low educated parents (e.g. 70% at lower high school, and over 40% at upper high school). Partly because of this, the share of enrolled children from worse-off parental background decreases as we move up the education cycle, while that from better-off parental background increases. The share of children from medium parental background enrolled and completing each level is stable across the educational path.

Second, afro descendants are not underrepresented in the enrolment distribution. However, the proportion of afro descendants that drop out at each stage nearly doubles the proportion of those enrolled at each level. Third, as expected, there is positive selection across schooling levels, i.e. the proportion of students with worse performance (in primary or secondary levels) decreases across schooling levels. It is worth noting that the percentage of students enrolled in postsecondary education who have repeated primary is almost zero for both genders.

Finally, risky behaviours (tried marijuana before age 15), that we use to proxy for non-cognitive ability, are more prevalent among boys but seem to have similar detrimental effects on both genders, as the share of drop outs is 50% larger than the share of enrolled. Having high motivation helps survive, i.e. the proportion of highly motivated students increases across schooling stages for both genders.

[7]Afro-descendance is captured in the ECH through the following question: *"Do you believe you have… (black or afro, Asian, white, native, other) descent?".* The respondent can choose more than one option of racial descent. For this study, individuals reporting having black or afro descent are classified as afro-descendants. Non-afro-descendants are all individuals reporting not having afro-descent (thus, including whites, Asian, native or other). Almost 90% declares *only* white descent, while less than 5% declares having native or other descent.

Overall, the raw data suggests a selection process to take place over the educational path, driven by children's ethnicity, parental background, and multiple abilities. Moreover, these variables seem to have differential effects at different stages and by gender. This preliminary evidence, thus, motivates the use of sequential models as well as performing separate analyses by gender.

4. Empirical strategy

This paper addresses two questions. First, to what extent long-term family factors, such as parental education, cognitive and non-cognitive abilities and individual's ethnicity, and short-term factors, such as liquidity constraints, influence education attainment? Second, is there any differential effect of long- and short-term factors at different stages of the schooling process?

To answer these questions our estimation strategy follows Cameron and Heckman (1998, 2001), where education attainment is analysed through a dynamic discrete choice model of schooling progression. This strategy recognizes that education attainment is the outcome of previous schooling choices, which in turn depend on individuals' observable characteristics, like gender, ethnicity, and family background, but are also influenced by unobservable characteristics, such as motivation or conscientiousness. The probability that an individual enters post-secondary education depends on upper high school graduation, which in turn depends on completing lower high school, making the model fundamentally recursive. The model also takes due account of two possible sources of bias: unobserved heterogeneity and the self-selection that takes place at different stages of the schooling process.

4.1 A sequential model of schooling progression

Following Cameron and Heckman (2001) the model assumes that each individual *i* takes schooling decisions based on a sequential choice model. The choices available to the individual are constrained by their earlier schooling choices.

The expected utility derived from each educational level is modelled as a latent utility index y_{is}^*:

$$y_{is}^* = X_{is}'\beta_s + \alpha_s\theta_i + u_{is} \;\; i = 1, \dots, N; \; s = 1, \dots, S \qquad (1)$$

where X_{is} is a vector of observed constraints and expectation variables relevant to schooling decision *s*, and θ_i are individuals-specific and time-invariant factors that are unobserved by the econometrician but known to the agent, such as individual ability, motivation, or preferences.u_{is} represents an idiosyncratic error term, which is assumed to be independent of the explanatory variables ($X_{is}$and θ_i), independent across individuals, and normally distributed, i.e. $u_{is}\sim N(0,1)$

Then, we can define the binary outcome y_{is}

$$y_{is} = \begin{cases} 1 & \text{if } y_{is}^* \geq 0 \\ 0 & \text{otherwise} \end{cases} \quad (2)$$

These assumptions allow writing down the probability of taking choice *s* as a probit model. Conditioning on θ,

$$\Pr(y_{is} = 1 \mid X_{is}, \theta_i, y_{is-1}) = \Phi(X_{is}'\beta_s + \alpha_s\theta_i) \quad (3)$$

where y_{is-1} are the past decisions made by the individual *i* and $\Phi(\cdot)$ is the standard normal cumulative distribution function.

The probability of any sequence of schooling choices made by the individual y_{is} given the observed variables and θ_i can be expressed as:

$$\prod_{s\,\epsilon\,C_i}[\,Pr(y_{is} = 1 \mid X_{is}, \theta_i, y_{is-1})]^{y_{is}}\,[Pr(y_{is} = 0 \mid X_{is}, \theta_i, y_{is-1})]^{1-y_{is}} \quad (4)$$

where C_i is the set of decision nodes individual *i* has visited.

We consider three education levels: lower high school (y_{i1}), upper high school (y_{i2}) and postsecondary education (y_{i3}). The sequential process for individual *i* consists on: first deciding whether to complete lower high school based on the underlying and unobserved expected utility (y_{i1}^*). After completing lower high school, the individual decides whether to complete upper high school (y_2) conditional on the expected utility (y_{i2}^*). Finally, individuals graduating from upper high school choose whether to enrol in postsecondary education (y_3) conditional on the expected utility of this choice (y_{i3}^*).

For each of the educational levels stated before, the conditional probabilities are the following. For not completing lower high school:

$$\Pr(y_{i1} = 0 \mid X_{i1}, \theta_i) = 1 - \Phi(X'_{i1}\beta_1 + \alpha_1\theta_i) \quad (5)$$

For completing lower high school and not continuing:

$$\Pr(y_{i1} = 1 \mid X_{i1}, \theta_i) = \Phi(X'_{i1}\beta_1 + \alpha_1\theta_i) \quad (6)$$

For not completing upper high school:

$$\Pr(y_{i2} = 0 \mid X_{i2}, y_{i1}\theta_i) = \Phi(X'_{i1}\beta_1 + \alpha_1\theta_i) - \Phi_2(X'_{i1}\beta_1 + \alpha_1\theta_i, X'_{i2}\beta_2 + \alpha_2\theta_i, \rho_{12}) \quad (7)$$

For completing upper high school and not continuing:

$$\Pr(y_{i2} = 1 \mid X_{i2}, y_{i1}\theta_i) = \Phi_2(X'_{i2}\beta_2 + \alpha_2\theta_i, X'_{i1}\beta_1 + \alpha_1\theta_i, \rho_{12}) - \Phi_3(X'_{i1}\beta_1 + \alpha_1\theta_i, X'_{i2}\beta_2 + \alpha_2\theta_i, X'_{i3}\beta_3 + \alpha_3\theta_i, \rho_{12}, \rho_{13}, \rho_{23}) \quad (8)$$

Enrolling in postsecondary education:

$$\Pr(y_{i3} = 1 \mid X_{i3}, y_{i2}, \theta_i) = \Phi_3(X'_{i1}\beta_1 + \alpha_1\theta_i,\ X'_{i2}\beta_2 + \alpha_2\theta_i,\ X'_{i3}\beta_3 + \alpha_3\theta_i, \rho_{12}, \rho_{13}, \rho_{23}) \quad (9)$$

where $\Phi(\cdot)$ is the standard normal cumulative distribution function, $\Phi_2(\cdot)$ is the bivariate standard normal cumulative distribution with correlation coefficient ρ_{12}, and $\Phi_3(\cdot)$ is the trivariate standard normal cumulative distribution with correlation coefficients $\rho_{12}, \rho_{13}, \rho_{23}$.

$$\rho_{12} = cov[u_1, u_2|X_1, X_2], \qquad \rho_{13} = cov[u_1, u_3|X_1, X_3], \qquad \rho_{23} = cov[u_2, u_3|X_2, X_3]$$

The model is estimated using maximum-likelihood of the joint trivariate sample selection model.[8]

4.1.1 Explanatory variables

Our variables of interest are parental educational background, ethnicity, and children's multiple abilities. Parental education distinguishes between mother's and father's highest educational level attained, divided in three categories: low (less than 9 years), medium (9 to 12 years), or high (more than 12 years).

In line with previous literature, the suggestive evidence shown above, suggests that ethnicity is an important determinant of school progression. As explained in Section 3, our ethnicity dummy variable indicates whether individuals are Afro-descendent.

[8] This technique ensures consistent estimators (Rosenman et al., 2010).

Cognitive ability has been found to correlate with grade repetition (e.g. McCoy and Reynolds, 1999). Since there is no direct measure of cognitive ability in our datasets, we use grade repetition as a proxy of cognitive ability.[9] We consider whether the child never repeated, repeated once or more than once primary level. For upper high school completion and post-secondary enrolment, we also include whether the individual never repeated, repeated once or more than once secondary level.[10]

Since our datasets do not include direct measures on non-cognitive ability, such as the measures included in the Big Five model or locus of control, we resort to two proxy variables. Recent literature suggests that having an interest in learning have a positive relationship with educational attainment (Lundbert, 2013; Almlund et al., 2011). Thus, we use motivation for enrolment in secondary education, as our first proxy for non-cognitive ability. We categorize the enrolment motives as: high motivation (those individuals reporting high value of education), medium motivation (people reporting that they enrol but are seeking employment), and low motivation (those enrolled because they were "pushed to").

Following the psychological literature, Heckman et al. (2011) and Heckman et al. (2014) suggest using behaviours that have proved to be strongly correlated with personality traits and that are known to affect school progression, such as conscientiousness and agreeableness. These behaviours include having tried marijuana, violent behaviour, daily smoking, regular drinking, and having had intercourse before age 15. Our second proxy variable of non-cognitive ability is whether the individual has tried marijuana before age 15, which is negatively related with conscientiousness (Gullone and Moore, 2000), and has a negative effect on schooling progression (Heckman et al., 2014).[11]

The study track chosen captures unobserved individual cognitive and non-cognitive skills and may reflect self-selection if more able individuals choose general academic education instead of vocational training (van Elk et al., 2011). The schooling system in Uruguay offers two tracks: Vocational training education, which is more oriented toward job placement, and general academic education, which allows direct

[9] Countries with a larger proportion of retained students have a lower performance in PISA test (OECD, 2011; Ikeda and García, 2014). Also, Hill (2014) employs repetition to define low-achievers.
[10] Note that cognitive ability is likely to be influenced by child's environment, such as parental education, issue that is controlled for in the analysis.
[11]Other risky behaviours used in the literature, such as having had intercourse or emancipation before 15 were found not statistically significant for schooling progression.

access to University. Since there are no significant differences in curricula between general education and vocational training at lower high school level, we only include the track chosen in upper high school.

Parental investment is an important variable in the production function of education (Checchi, 2006). Given the lack of data on parental inputs, we use a variable indicating whether the student went to a public (with no tuition fees) or a private (with positive tuition fees) school as a proxy of parental investment. Since private schools offer on average better infrastructures, better peers and teachers, and lower students to teacher ratios, this variable acts also as a school quality variable.[12] In particular, we use a dummy variable that indicates whether the individual attended all grades of the corresponding schooling level in a public institution or he took at least one grade in a private institution.

Since distance to the education centre reduces the likelihood of enrolling, and over the sample period universities are mainly located in Montevideo, we also control for the Department where the individual attended upper high school when modelling enrolment in postsecondary education.

Finally, age cohort fixed effects are included in all stages, while dummy variables indicating whether the student attended pre-school as well as the type of institution attended in primary level are also included when modelling lower high school completion.

4.1.2 Exclusion restrictions

Identification requires a subset of variables influencing the probability of attaining a certain educational level and not directly affecting the probability of completing the next one. Exclusion restrictions are also assumed to be independent of the model unobservables.

As in previous studies, our exclusion restrictions reflect labour market conditions, which determine the opportunity cost of education, at the time the relevant decisions are taken (Cameron and Heckman, 2001; Heckman et al., 2014; Bernardi, 2012; Pal, 2004). At each schooling stage, the individual chooses between completing the education level and dropping out to participate in the labour market. The decision is taken considering current labour market conditions and expectations on future returns to education. If the individual continues in the educational system, the decision to attain the next schooling

[12] Checchi (2006) provides an overview of the influence of supply of education and education financing on education attainment.

stage will depend on the opportunity cost of education at the time the decision of completing the level is evaluated and will not directly depend on the opportunity cost several years before. In other words, labour market conditions at time *t* influence schooling choices at time *t*, only indirectly affecting schooling decisions of the next level taken at *t+1*. Clearly, if the individual decides to drop out from the system at lower high school he is indirectly deciding not to attain upper high school, because of the sequential process of education attainment, but the individual cannot decide completing upper high school if lower high school was not achieved. In addition, individual's education choices do not affect labour market conditions.

A priori, the influence of local labour market conditions is unclear. On the one hand, a high probability of employment may induce students to quit school and enter the labour market. On the other hand, the higher expected education returns could be a stimulus for acquiring further education (Moccetti, 2012).

We employ gender-specific unemployment and employment rates for people aged 24 or less, computed at department level. As far as employment is concerned, we consider unskilled youth employment rate for children deciding whether to complete lower high school, semi-skilled youth employment rate for those choosing to complete upper high school, and youth skilled employment rate for individuals considering post-secondary enrolment. It is worth noting that although the minimum legal age for participating in the labour market is 15 years old, child and adolescent labour is commonly observed in Uruguay, as in many other Latin American countries.[13]

5. Results

5.1 Unobserved heterogeneity and correlations

A trivariate probit model with sample selection is estimated separately for boys and girls —see Table 4.[14] The joint statistical significance of the cross-equation correlations of unobservables shown by the Wald tests at the bottom of Table 3 highlights the importance of estimating education attainment as a sequential process and provides evidence that not

[13] 13% of the population aged between 12 and 29 declared having a first job (for at least three months) before 15 years old in the ENAJ. Likewise, 24% of secondary school drop outs aged less than 15 declare "because started to work" as the main reason for leaving education.
[14]We use the cmp command in Stata. See Roodman (2010).

accounting for the endogeneity resulting from unobserved heterogeneity would induce biased results.[15]

We find cross-equation correlations to be negative. Any interpretation of this result is difficult. Recall that proxies for cognitive and non-cognitive skills are included in the model. Therefore, the negative correlations are capturing the effect of unobservables other than observed ability, motivation, and risky behaviours.

The selection process implied by the negative correlations may capture the effect of different study tracks, which students choose at lower high school (see Section 3). Less academically able students self-select into the vocational track, which increases their chances to complete lower high school, as the vocational track curricula is better suited for their skills (Meer, 2007). However, these same skills, such as lower taste for formal education, higher impatience, or less perseverance, makes them less likely to complete the next education level, high secondary school. The same argument is also likely to hold for the different academic field tracks (i.e. scientific, biological sciences, and humanistic) if students also self-select into field tracks.

5.2 Empirical findings

Table 4 presents average marginal effects capturing direct effects of our variables of interest on the probability of completing lower and higher secondary school and of enrolling in post-secondary school, by gender. Since we are examining different outcomes for secondary school and post-secondary school, we discuss our findings separately, starting with secondary school.

Family background stands out as an important determinant of academic success. In general, children from better educated parents are more likely to progress further in their education. However, these effects are far from being homogeneous. Consistent with recent evidence (Cameron and Heckman, 1998, 2001; Colding, 2006; Colding et al., 2009; Holm and Jaeger, 2011), our sequential model identifies heterogeneous effects of family background by education stage and gender. Parental education matters the most at the early stage of secondary schooling, which indicates that the strongest selection occurs at the lower level. The size of this effect can be substantial: the likelihood of completing lower secondary school, for instance, is up to 20 percentage points (pp) larger for boys from highly educated parents than for those raised in a low education household.

[15]Table A.1 in the Appendix shows that not accounting for selection overestimates the effects of the key variables on education attainment for girls and boys separately.

We also find heterogeneous effects by gender, both of the parents and of the children. While mother's education seems more important for girls, father's education has a greater influence on boys' performance. Both own- and cross-gender effects between parents and offspring have been found in related literature. For instance, while Anger and Heineck (2009) find strong own-gender transmission of cognitive ability in Germany, Black et al. (2005) provide evidence of cross-gender transmission of education in Norway, and Dohmen et al. (2012) find cross-gender transmission of trust attitudes in Germany. Mixed evidence is reported by Ermisch and Francesconi (2002) in their analysis of earnings intergenerational mobility in Britain.

Cognitive ability, proxied here by performance in previous education levels, comes out as an important factor in explaining exits from the education system. As students advance in the schooling system, previous grade retention has a larger detrimental effect on current completion. For instance, repeating once at secondary has a detrimental effect on upper secondary school completion (25 pp), which is 2.5 times larger than the effect of repeating once at primary school on lower secondary school completion (10.6 pp). Note also that beyond the indirect effect of student's performance at primary school on upper secondary completion, through the reduced probability of lower secondary completion, grade retention in primary school has also a sizeable direct effect —which amounts to 15.6 pp for girls and to 19.3 pp for boys. Thus, consistent with Cameron and Heckman (2001), differences in cognitive ability appear at early ages and persist over time.

The two non-cognitive trait proxies we consider prove to be important only at secondary school. Motivation is mostly relevant at lower secondary, while marijuana consumption before 15, which can only be relevant from upper secondary onwards, is only significant for boys at this level. The gender differences in our estimates are consistent with standard evidence in psychology on male and female adolescents having different personality traits and propensity to be engaged in risky behaviours (Gullone and Moore, 2000).

Consistent with the existing literature,[16] conditional on family background, cognitive and non-cognitive abilities, liquidity constraints and other controls, ethnicity still has a detrimental significant effect on completing the two levels of secondary school, mostly for girls.

[16] See Gao and Postiglione (2015) for a recent survey.

The labour market opportunities students face are important to understand school leaving behaviour. Two variables capture the opportunity costs of education: age/gender/department specific unemployment and age/gender/department/skill specific employment rates. Interestingly, employment and unemployment rates influence girls and boys differently. While girls react to unemployment, it is employment that affects boys. As expected, higher opportunity costs in the form of better labour market conditions increase the dropout probability for boys. This could reflect short-run family resource constraints. Children belonging to households with larger financial difficulties are more likely to drop out from school to complement family's income. Girls also behave like this at upper secondary school, but not at lower secondary school, where the probability of completing this compulsory stage of secondary education is smaller in regions with higher unemployment rates. This relationship may seem surprising, but it is consistent with at least two explanations. The first one is related to school quality, a factor we cannot fully capture in our empirical analysis. If higher unemployment regions provide lower quality schools, the relationship may capture the effects of school quality, as grade completion is positively related to school quality (Hanushek et al., 2008). The direct relationship between bad labour market conditions and bad performance could reflect also girls' labour market expectations. They may be discouraged to continue investing in human capital if they perceive that the labour market does not provide great opportunities for them, thus dropping out from the system.

When children reach the gates of post-secondary school the largest chunk of the selection process has already taken place. Because of this, most of the factors that shape the composition of the pool of students at secondary school play no significant role in the enrolment decision to post-secondary studies. Only parental education, bad performance at primary, distance to the University, and opportunity costs influence such decision for boys, with the expected signs. Girls' enrolment is only affected if fathers have higher education. Once again it is worth stressing the persistent and sizeable effect of doing badly at primary school, reducing the likelihood of post-secondary school enrolment by 25pp.

Overall our results are in line with the recent literature, which stresses the larger importance of long-run family factors, captured in our analysis by parental background, cognitive and non-cognitive skills, over the more limited role of short-term credit constraints, proxied here by the opportunity cost of education (Cameron and Heckman, 1998, 2001)

One concern that could arise in this type of studies is that socio-emotional endowment influences cognitive abilities and the other way around (Heckman and Moso, 2014). To this end, we include two interaction terms: between motivation for enrolment in secondary and repetition in primary, on the one hand, and performance in secondary, on the on the hand. Appendix Table A.3 shows that these interactions are not statistically significant, thus reinforcing previous results shown in Table 4.

6. Conclusions

Since schooling is a sequential process, we use the sequential probability model developed by Cameron and Heckman (1998, 2001) to examine whether and to what extent long-term family factors —such as parental educational background, ethnicity, cognitive and socio-emotional endowments— as well as short-term family income —proxied by the opportunity cost of education— influence children's education attainment at each stage of the education system.

We work with a unique dataset for Uruguay, which results from matching information from two nationally representative data sets: the 2008 National Youth Survey (ENAJ) and the 2008 Continuous Household Survey (ECH). We have information on complete educational trajectories, including performance indicators such as repetition, family background, motives for attending secondary school, risky behaviours of interest, such as drug consumption, and socio-economic characteristics of the individuals.

Our findings suggest that long-term factors matter across all education stages while the effect of short-term factors wear out as individuals progress in the education system, suggesting a severe selection process at early stages. These findings have important policy implications. Since selection at early stages depends on family background, ethnicity or non-cognitive skills, free access to education does not guarantee that individuals from worse-off family backgrounds (i.e. less able individuals and from lower parental educational backgrounds) achieve higher education. Instead, well targeted and designed policy interventions at different stages of schooling progression may help levelling the playing field for children from different parental educational backgrounds, ethnicity, scholastic and non-cognitive abilities. For instance, policies intended to enhance cognitive ability early in life and to promote social and behavioural skills in adolescence and youth, coming especially from more disadvantaged environments who probably receive little encouragement and support at home, should be explored.

Our results also indicate that the different socio-emotional abilities that boys and girls have across their life cycle give rise to gender-based inequalities in schooling progression. Thus, promoting cognitive and non-cognitive abilities from a gender perspective and considering ethnical/ racial diversity may have positive effects on children's educational achievement.

Like other neighbouring countries (e.g. Colombia), Uruguay started a process to increase the public supply of university education by opening new branches of the main University across the country. Expanding and decentralising supply in postsecondary education may reduce costs, increase expected returns (Bratti et al., 2008), and thus increase enrolment. However, if no attempt is made to ameliorate the strong selection that our estimates suggest, the higher education expansion policy may end up having a reduced effect on the worse off, as it has already been documented for other countries (see Bratti et al. (2008) for Italy, and Oviedo and Ramos (2016) for Colombia)

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TABLES AND FIGURES

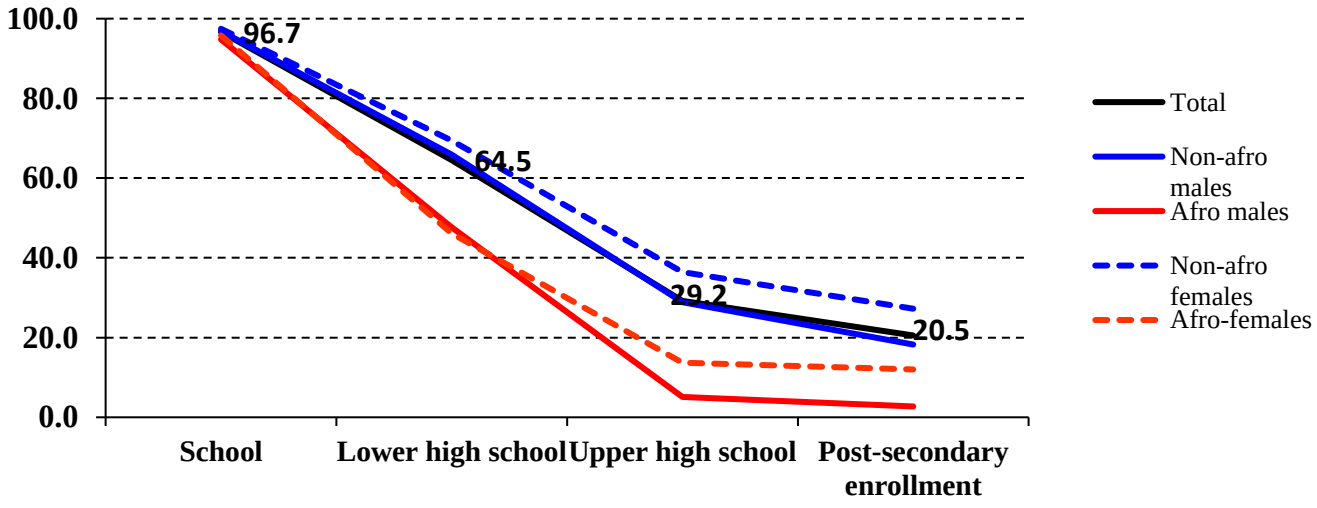
Chart 1. Structure of the Education System in Uruguay

School cycle	School type	Grades	Theoretical ages	Compulsory
Pre-school	Kindergarden (Centros CAIF, Guarderías)	0	4-5	No*
Primary	School (Escuela)	1-6	6-11	Yes
Lower high school (Ciclo básico)	General education (Liceo)	7-9	12-14	yes
	Vocational-training (UTU)			
Upper high school (Bachillerato)	General education (Liceo)	10-12	15-17	No*
	Vocational-training (UTU)			
Post-secondary	University/ Teaching Training Institutes/ Tertiary education (vocational training) / Tertiary education- Non-University Institutes (private institutions)	5 yr.	18-23	No

* Since December 2008 these levels are compulsory.

Figure 1. Progression rates at different schooling stages, by gender and ethnicity**. (%)[1]**

Source: own elaboration based on ENAJ (2008)



Source: own elaboration based on ENAJ (2008)

1. Graduation rate of total population aged 20 to 29 at primary and secondary educational level,and enrollment rate in tertiary education.

Table 1. Summary statistics of variables common to all education stages (%)

Variable	Total	Female	Male	No afro	Afro
Female	52.28			51.7	57.4
Afro-descendant	10.60	11.64	9.46		
Parents' background					
Mother's education					
Low level	47.77	48.31	47.17	45.69	65.34
Medium level	36.78	36.20	37.43	37.84	27.89
High level	15.45	15.49	15.40	16.47	6.77
Father's education					
Low level	52.40	54.09	50.53	50.40	69.32
Medium level	36.11	34.83	37.52	37.22	26.69
High level	11.49	11.08	11.95	12.38	3.98
Attended pre-school	83.16	82.58	83.81	84.14	74.90
Completed primary level	97.52	98.23	96.73	97.84	94.82
Public school (all years)	76.80	76.95	76.64	75.56	87.25
Obs.	2,349	1,228	1,121	2,100	249

Table 2. Summary statistics across the schooling progression by gender (%)

Variable	Lower high school			Upper high school			Post-secondary		Total
	Enrolled	Drop-out	Completed	Enrolled	Drop-out	Completed	Not enrolled	Enrolled	
Panel A. Girls									
Afro	9.8	17.9	8.2	7.4	11.6	5.0	4.7	5.1	11.6
Parental education									
Low edu mother	44.5	76.1	38.2	34.2	49.7	25.7	37.8	22.0	48.5
Medium edu mother	38.4	21.7	41.7	43.4	42.5	43.8	47.2	42.8	36.0
High edu mother	17.1	2.2	20.1	22.5	7.9	30.4	15.0	35.2	15.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Low edu father	50.8	72.8	46.4	43.5	56.2	36.6	50.4	32.3	54.1
Medium edu father	37.2	25.5	39.5	41.1	37.3	43.1	39.4	44.3	34.9
High edu father	12.1	1.6	14.2	15.5	6.5	20.3	10.2	23.5	11.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Performance in Primary									
Never repeated	83.9	53.3	90.1	92.3	83.9	96.8	92.9	98.0	78.1
Repeated once	13.6	37.0	9.0	7.4	15.1	3.2	7.1	2.0	16.5
Repeated 2+	2.4	9.8	1.0	0.4	1.0	0.0	0.0	0.0	5.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Performance in Secondary									
Never repeated				64.7	33.6	81.7	66.1	86.6	60.4
Repeated once				22.9	40.1	13.6	25.2	10.0	25.5
Repeated 2+				12.3	26.4	4.7	8.7	3.4	14.1
Total				100.0	100.0	100.0	100.0	100.0	100.0
Noncognitive abilities									
Tried marijuana before 15yr	2.5	4.9	2.1	2.1	2.7	1.7	1.6	1.7	2.4
Motivation to enrolment									
Highly motivated	77.8	57.1	81.9	83.5	78.4	86.2	81.9	87.5	77.8
Labour motives	6.0	17.4	3.7	3.0	5.8	1.5	1.6	1.5	6.0
Not motivated	13.9	20.1	12.6	11.8	14.0	10.6	13.4	9.8	13.9
Other motives	2.3	5.4	1.7	1.7	1.7	1.7	3.1	1.2	2.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Obs.	1,109	184	925	828	292	536	127	409	1,228

Table 2. Summary statistics across the schooling progression by gender (%) (cont.)

Variables	Lower high school			Upper high school			Post-secondary		Total
	Enrolled	Drop-out	Complete	Enrolled	Drop-out	Complete	Not enrolled	Enrolled	
Panel B. Boys									
Afro	8.9	15.0	7.3	6.7	9.8	4.0	6.0	3.1	9.456
Parental education									
Low edu mother	43.2	74.0	35.5	32.0	40.4	24.8	41.0	17.6	47.4
Medium edu mother	40.0	25.0	43.7	45.3	45.9	44.9	43.6	45.4	37.29
High edu mother	16.8	1.0	20.7	22.7	13.8	30.3	15.4	37.0	15.34
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Low edu father	47.5	74.5	40.7	37.4	47.4	28.8	50.4	19.1	50.5
Medium edu father	39.5	25.0	43.1	44.5	42.8	45.9	44.4	46.6	37.56
High edu father	13.0	0.5	16.1	18.1	9.8	25.3	5.1	34.4	11.95
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Performance in Primary									
Never in primary	78.9	52.0	85.6	89.0	81.0	95.8	89.7	98.5	72.6
Once in primary	17.2	37.0	12.3	10.2	17.4	4.0	10.3	1.1	19
2+ in primary	3.9	11.0	2.1	0.8	1.5	0.3	0.0	0.4	8.385
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Performance in Secondary									
Never in secondary				54.5	32.4	73.6	67.5	76.3	50.4
Once in secondary				25.2	34.6	17.2	20.5	15.6	28.36
2+ in secondary				20.3	33.0	9.2	12.0	8.0	21.19
Total				100.0	100.0	100.0	100.0	100.0	100.0
Noncognitive abilities									
Tried marijuana before 15yr	5.8	9.5	4.8	4.8	7.3	2.6	0.9	3.4	6.244
Motivation to enrolment									
Highly motivated	72.8	56.5	76.9	78.0	75.2	80.5	78.6	81.3	72.8
Labour motives	8.6	16.0	6.7	5.7	7.0	4.5	7.7	3.1	8.557
Not motivated	13.5	19.0	12.2	12.3	12.8	11.9	10.3	12.6	13.53
Other motives	5.1	8.5	4.2	4.0	4.9	3.2	3.4	3.1	5.075
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Obs.	1,005	200	805	706	327	379	117	262	1,121

Table 3. Estimated correlations of unobservables and test of ignorability

	Girls		Boys	
Correlations of unobservables	*Estimate*	*p-value*	*Estimate*	*p-value*
ρ_{12}(Complete Upper HS, Complete Lower HS)	-0.740	0.032	-0.489	0.05
ρ_{13} (Completing Lower HS, Postsec enrollment)	-0.123	0.72	-0.177	0.482
ρ_{23} (Completing Upper HS, Postsec enrollment)	-0.01	0.96	-0.544	0.039
	χ^2	*p-value*	χ^2	*p-value*
Wald test of ignorability				
$Ho: \rho_{12} = \rho_{13} = \rho_{23} = 0$	12.96	0.0047	31.21	0.0000

Ho: Sample selection is ignorable.

Table 4. Probability of completing lower and higher secondary school and of enrolling in post-secondary school, by gender. Average marginal effects

	Girls			Boys		
Variables	**Lower HS (1)**	**Upper HS (2)**	**Post-secondary (3)**	**Lower HS (4)**	**Upper HS (5)**	**Post-secondary (6)**
Afro-descendants	-0.053***	-0.117**	0.096	-0.02	-0.131*	-0.105
Parental education (Ommited: low level of education)						
Mother's edu level medium	0.056***	0.055*	-0.015	0.057***	-0.016	0.014
Mother's edu level high	0.120***	0.166***	0.072	0.190***	0.049	0.109*
Father's edu level medium	0.033**	0.037	0.047	0.039**	0.069*	0.123**
Father's edu level high	0.052	0.102**	0.101**	0.199***	0.137**	0.330***
Ommited variables in repetition (Never repeated)						
Repeated once school	-0.106***	-0.156***	-0.057	-0.106***	-0.193***	-0.250*
Repeated school 2+	-0.163***	.	.	-0.151***	-0.117	.
Repeated once secondary	.	-0.250***	-0.085	.	-0.291***	0.019
Repeated secondary 2+	.	-0.324***	-0.019	.	-0.371***	0.063
Motives for enrollment in secondary (Omitted: highly motivated)						
Not motivated	-0.137***	-0.174**	0.008	-0.102***	-0.011	.
Labor motives	-0.043**	-0.025	-0.02	-0.082***	-0.003	.
Other motives	-0.084**	0.026	-0.157	-0.087***	0.023	.
Marijuana before 15	.	-0.09	.	.	-0.183**	0.193
Opportunity cost of education						
Unemployment specific-rate	-0.127**	0.271*	-0.311	-0.149	-0.034	0.735*
Employment specific-rate	.	-0.014	0.218	-0.370***	-0.530**	-0.248
Lower high school						
Public institution	-0.110***	-0.145***	.	-0.067*	.	.
All years in public school	-0.079***	.	.	-0.164***	.	.
Attended pre-school	0.054***	.	.	0.031	.	.
Upper high school						
Public institution	.	0.029	.	.	-0.033	.
General education	.	0.205***	.	.	0.197***	.
Departament when enrolled in uper high school (Ommited: Montevideo)						
Cerro Largo	.	.	.	.		-0.351**
Lavalleja	.	.	.	.		-0.234*
Rivera	.	.	.	.		0.444***
Obs.	1109	825	536	994	706	378

* p<0.1, ** p<0.05, *** p<0.01

Note: the models include cohort fixed effects. We also included 18 dummy variables, one for each Department in which students lived during attendance to upper high school.

APPENDIX

Table A.1 Summary Statistics by gender and ethnicity

Variable	Total	Female	Male	No afro	Afro
Female	0.52			51.7	57.4
Afro-descendant	0.11	0.12	0.09		
Parents' background					
Mother's education					
Low level	0.48	0.48	0.47	0.46	0.65
Medium level	0.37	0.36	0.37	0.38	0.28
High level	0.15	0.15	0.15	0.16	0.07
Father's education					
Low level	0.52	0.54	0.51	0.50	0.69
Medium level	0.36	0.35	0.38	0.37	0.27
High level	0.11	0.11	0.12	0.12	0.04
Attended pre-school	0.83	0.83	0.84	0.84	0.75
Completed primary level	0.98	0.98	0.97	0.98	0.95
Public school (all years)	0.77	0.77	0.77	0.76	0.87
Obs.	2,349	1,228	1,121	2,100	249

ENAJ (2008), ECH (2008)

Table A.2 Simple probit by gender

	Girls			Boys		
Variables	**Lower HS (1)**	**Upper HS (2)**	**Post-secondary (3)**	**Lower HS (4)**	**Upper HS (5)**	**Post-secondary (6)**
Afro-descendants	-0.400***	-0.449**	0.271	-0.154	-0.516**	-0.618
Parental education (Ommited: low level of education)						
Mother's edu level medium	0.427***	0.221*	0.068	0.397***	0.045	0.12
Mother's edu level high	0.915***	0.658***	0.512***	1.340***	0.310*	0.578**
Father's edu level medium	0.250**	0.163	0.261*	0.275**	0.295**	0.645***
Father's edu level high	0.381	0.425**	0.543**	1.486***	0.558***	1.536***
Ommited variables in repetition (Never repeated)						
Repeated once school	-0.802***	-0.650***	-0.605*	-0.737***	-0.846***	-1.395***
Repeated school 2+	-1.234***	.		-1.048***	-0.776	.
Repeated once secondary		-1.016***	-0.691***		-1.026***	-0.186
Repeated secondary 2+		-1.315***	-0.622**		-1.329***	-0.166
Motives for enrollment in secondary (Omitted: highly motivated)						
Not motivated	-1.040***	-0.662**	-0.137	-0.628***	0.005	.
Labor motives	-0.336**	-0.109	-0.105	-0.519***	-0.061	.
Other motives	-0.649**	0.065	-0.65	-0.599***	0.048	.
Marijuana before 15	.	-0.358	.	.	-0.647**	0.738
Opportunity cost of education						
Unemployment specific-rate	-0.948**	0.754	-1.3	-1.121	-0.049	
Employment specific-rate	.	0.09	0.92	-2.602***	-1.919**	-0.378
Obs.	1109	825	536	994	706	378

* p<0.1, ** p<0.05, *** p<0.01

Note: the models include cohort fixed effects, a dummy variable for pre-school attendance in lower high school, a dummy variable for public institution attended in each educational level, unemployment and employment specific gender rates at each specific stage in the schooling transitions, and dummy variables for the Department of residence when attaining upper high school included in the last stage.

Table A.3 Educational path by gender with interactions between motivation and repetition. Average marginal effects

	Girls			Boys		
	Lower	**Upper**	**Postsecondary**	**Lower**	**Upper**	**Postsecondary**
Variables						
Afro-descendants	-0.051**	-0.130***	0.093	-0.017	-0.132*	-0.087
Parental education (Ommited: low level of education)						
Mother's edu level medium	0.056***	0.054*	-0.015	0.059***	-0.016	0.014
Mother's edu level high	0.119***	0.169***	0.072	0.195***	0.045	0.102*
Father's edu level medium	0.033**	0.037	0.048	0.040**	0.065*	0.112**
Father's edu level high	0.052	0.105**	0.101**	0.199***	0.116**	0.307***
Multiple abilities						
Ommited variables in repetition (Never repeated)						
Repeated once school	-0.112***	-0.166***	-0.057	-0.100***	-0.203***	-0.217
Repeated school 2+	-0.166***	.	.	-0.124***	-0.176	.
Repeated once secondary	0.000	-0.243***	-0.078	.	-0.275***	0.042
Repeated secondary 2+	0.000	-0.326***	-0.017	.	-0.359***	0.086
Motives for enrollment in secondary (Omitted: highly motivated)						
Not motivated	-0.144***	-0.085	-0.012	-0.100***	-0.041	.
Labor motives	-0.054**	-0.043	-0.022	-0.068***	0.024	.
Other motives	-0.057	0.145	-0.180	-0.057	0.112	.
Marijuana before 15	.	-0.083	.	.	-0.152**	.
Interactions						
Repeated once school*Not motivated	0.020	.	.	0.016	.	.
Repeated once school*Labor motives	0.048	.	.	-0.015	.	.
Repeated once school*other motives	-0.066	.	.	-0.085	.	.
Repeated school2+*Not motivated	.	.	.	-0.069	.	.
Repeated school2+*Labor motives	0.040	.	.	-0.117	.	.
Repeated school2+*other motives	0.004	.	.	-0.049	.	.
Repeated secondary once*Not motivated	.	-0.116	.	.	-0.025	.
Repeated secondary once*Labor motives	.	-0.007	.	.	-0.024	.
Repeated secondary once* Other motives	.	-0.196	.	.	-0.166	.
Repeated secondary 2+*Not motivated	.	.	.	.	0.038	.
Repeated secondary 2+*Labor motives	.	0.127	.	.	-0.086	.
Repeated secondary 2+* Other motives	.	.	.	.	-0.168	.
Obs.	1109	825	536	994	706	378

* p<0.1, ** p<0.05, *** p<0.01

Note: the model includes the same variables used in Table 4.

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